

### REMARKS

Entry of the foregoing amendment and favorable consideration of the subject application is respectfully requested in view of the following comments.

Claims 9-15 and 22-27 are currently pending in this application, claims 16-21 having been previously cancelled. Claims 22-24, 26 and 27 (in part) have been withdrawn from consideration by the examiner subject to a provisional election with traverse and claims 9-15, 25 and 27(in part) have been rejected.

Claims 9, 22 and 27 have been amended in response to the examiner's action and new claim 28 has been added.

Claims 9 and 27 have been amended to more clearly recite the present invention as "A process for producing unsaturated aldehyde and unsaturated acid from C<sub>2</sub> to C<sub>5</sub> alkane ...". This is a clearly stated object of the present invention as noted at page 3, lines 9-12 of the specification:

"Another object of the invention is to provide a process for producing from lower alkanes corresponding unsaturated aldehydes and/or unsaturated carboxylic acids at high yield."

Claim 22 has been amended to limit the recitation to identifying the preferred form of the molybdenum-containing, multimetal mixed oxide catalyst employed in claim 9 in keeping with the specification, particularly Example 26.

New claim 28 has been added in response to the examiner's restriction requirement and corresponds to claim 27 rewritten to eliminate the specific forms of the molybdenum-containing, multimetal mixed oxide catalysts of Formula (2) and Formula (3), thereby reading on the invention of Group I as set forth in the examiner's restriction requirement.

No new matter has been added by these amendments and Applicants respectfully submit that they should be entered at this time.

#### ELECTION/RESTRICTION

Restriction to one of the following inventions has been required under 35 U.S.C. 121:

Group I, claims 9-15, 25 and 27 (in part), drawn to a process for producing unsaturated aldehydes and acids, using the following catalyst:  $MnE^1E^2O_x$ , classified in class 562, subclass various.

Group II, claims 22-23 and 27 (in part), drawn to a process for producing unsaturated aldehydes and acids, using the following catalyst:  $Mo_aBi_bFe_cA_dB_eC_fD_gO_x$ , classified in class 562, subclass various.

Group III, claims 24, 26 and 27 (in part), drawn to a process for producing unsaturated aldehydes and acids using the following catalyst  $Mo_nV_iW_jE_kF_lG_mH_nO_x$ , classified in class 562, subclass various.

The examiner contends that the inventions as claimed can have materially different design, mode of operation, function, or

effect, and that the processes are drawn to patentably distinct catalysts which do not overlap in scope.

A provisional election was made with traverse to prosecute the invention of Group I, claims 9-15, 25 and 27 (in part).

Applicants hereby affirm the election of Group I with traverse and point out that the present invention is a process for producing unsaturated aldehydes and unsaturated acids from a C<sub>2</sub> to C<sub>5</sub> alkane starting material comprising at least two steps and preferably three steps for the complete process. Although those steps may be chemically separable, procedurally they function together to present the unified process as claimed.

The fact that the catalysts recited in the present claims may themselves be patentably distinct is not relevant since the invention is not *per se* directed to the catalysts. Indeed, note the final phrase of claim 1:

"... subjecting the produced C<sub>2</sub> to C<sub>5</sub> alkene to vapor phase oxidation in the presence of molecular oxygen and a molybdenum-containing, multimetal, mixed oxide catalyst to produce unsaturated aldehyde and unsaturated acid."

When this phrase is considered in conjunction with claims 23 and 25, one could use other molybdenum-containing, multimetal, mixed oxide catalysts in the second and third steps of the overall claimed process. The molybdenum-containing catalysts of Formula (2) and Formula (3) are merely those that are preferred. As such, the overall process of the present invention is dependent

on the initial step of vapor phase oxidative dehydrogenation of a C<sub>2</sub> to C<sub>5</sub> alkane in the presence of molecular oxygen and an oxidative dehydrogenation catalyst comprising a multimetal mixed oxide of formula (1) as recited in the present claims.

The inclusion of the manganese-containing catalyst of Formula (1) has been found to overcome equilibrium limitations and high temperature requirements previously found in the conversion of lower C<sub>2</sub> to C<sub>5</sub> alkanes to their corresponding C<sub>2</sub> to C<sub>5</sub> alkenes from which unsaturated aldehydes and unsaturated acids are formed, thus improving the overall production of processes for such unsaturated aldehydes and unsaturated acids.

In addition, the inclusion of the herein claimed step 1 employing the recited manganese-containing catalyst of Formula (1) results in an improved oxidative dehydrogenation of the lower alkanes to lower alkenes from which the unsaturated aldehydes and acids are ultimately produced improving the yield thereof, and improvement of the overall process of generating unsaturated aldehydes and acids from lower C<sub>2</sub> to C<sub>5</sub> alkanes.

Accordingly, Applicants respectfully submit that the process of the present invention, as claimed herein, is a single process comprising the recited steps and that, while the manganese-containing catalyst of Formula (1) is required, the molybdenum-containing catalysts of Formula (2) and Formula (3) are merely those preferred for optimal performance and their use in the overall process is neither sought, nor recited, as an invention

separate and apart from that part of the process utilizing the manganese-containing catalyst of Formula (1).

In view of the foregoing, Applicants respectfully submit that only one invention is claimed, to wit, the process for producing unsaturated aldehyde and unsaturated acid from C<sub>2</sub> to C<sub>5</sub> alkane which comprises subjecting C<sub>2</sub> to C<sub>5</sub> alkane to vapor phase oxidative dehydrogenation in the presence of molecular oxygen and an oxidative dehydrogenation catalyst comprising a first multimetal, mixed oxide catalyst having the Formula (1) to produce C<sub>2</sub> to C<sub>5</sub> alkenes, further oxidizing the obtained C<sub>2</sub> to C<sub>5</sub> alkene in the presence of molecular oxygen and a second multimetal, mixed oxide catalyst having the Formula (2) to produce unsaturated aldehydes and unsaturated acids, and further oxidizing the obtained unsaturated aldehyde in the presence of molecular oxygen and a third multimetal, mixed oxide catalyst having the Formula (3) to produce unsaturated acid. The inclusion of the molybdenum-containing, multimetal, mixed oxide catalysts of Formula (2) and Formula (3) do not constitute separate inventions requiring restriction as they are an integral part of the recited process.

Applicants therefore respectfully request that the requirement for restriction be withdrawn and request that claims 9-15 and 22-28 as amended herein be fully considered on the merits.

**PRIORITY DOCUMENT**

The examiner has acknowledged Applicants' claim for foreign priority based on Japanese Application 135,420/98, filed in Japan on May 18, 1998. However, the examiner contends that Applicants have not filed a certified copy of the priority document as required by 35 U.S.C. 119(b).

The examiner is respectfully reminded that the present application is a divisional of Applicants' prior application Serial No. 09/895,416, now U.S. Patent 6,756,517, which was a divisional of Applicants' original application Serial No. 09/313,652, filed May 18, 1999, and in which the original claim for priority was made.

The certified copy of the Japanese priority document was filed in that original application and that filing was acknowledged by the examiner in the first Office Action of S.N. 09/895,416 as shown by the attached Exhibit A, a copy of the Office Action Summary form PTOL-326 from S.N. 09/895,416.

Applicants respectfully submit that the certified copy of the priority document has been duly filed and acknowledged as received by the Office in the prior applications and requests a similar acknowledgement of receipt by the examiner in the present application.

**Claim Rejections 35 USC §103**

Claims 9-10, 13-15, 25 and 27 (in part) have been rejected under 35 U.S.C. 103(a) as being unpatentable over Schlafer et al.

(U.S. Patent No. 4,078,004). (Applicants note that the number for this patent has been incorrectly stated in the present Office Action as 4,078,044). The office action states:

"The instant claims are drawn to a process for producing unsaturated aldehydes and unsaturated acids by vapor phase dehydrogenation of C2 to C5 alkenes with molecular oxygen by using an oxidative dehydrogenation catalyst with a multimetal mixed oxide as described in claim 1.

Schlaefer et al. teaches a process for producing unsaturated aldehydes and unsaturated acids by the vapor phase oxidative dehydrogenation of lower alkenes with molecular oxygen by using an oxidative dehydrogenation catalyst with a multimetal mixed oxide with the components  $Sb_{1-99}Mn_{1-50}O_x$ . (abstract; column 1, lines 9-14; column 2, lines 47-52; column 5, line 14; column 16, lines 13-14). The temperature range of the reaction is from 350°C to about 500°C (column 6, lines 7-10) and the catalyst can be supported on a variety of inorganic carriers (column 4, lines 1-17).

Schlaefer et al. is deficient in the sense that it does not exemplify Applicant's catalyst. Schlaefer et al. is also silent as to the drying temperature and the space velocity.

However, it would be prima facie obvious to one of ordinary skill in the art at the time of the invention, to determine the appropriate drying temperature, the space velocity and to use Schlaefer et al.'s multimetal mixed oxide for the oxidative dehydrogenation process. One of ordinary skill in the art would be motivated to optimize the process and to select a particular multimetal mixed oxide catalyst from the generic teachings of Schlaefer et al. with the reasonable expectation of success in obtaining the particular reaction products, that is, unsaturated aldehydes and acids. Absent any showing of unusual and/or unexpected results over Applicant's particular drying temperature and space velocity, the art obtains the same effect on the process steps. The expected result would be the efficient production of unsaturated aldehydes and unsaturated acids for the chemical industry."

Claims 9-15, 25 and 27 (in part) have been rejected under 35 U.S.C. 103(a) as being unpatentable over Schlaefer et al. (US

4,078,004), in view of Croce et al. (U.S. 3,937,746). The office action states:

"The instant claims are drawn to a process for producing unsaturated aldehydes and unsaturated acids by the vapor phase oxidative dehydrogenation of C2 to C5 alkenes with molecular oxygen by using an oxidative dehydrogenation catalyst with a multimetal mixed oxide as described in claim 1.

Schlaefer et al. teaches a process for producing unsaturated aldehydes and unsaturated acids by the vapor phase oxidative dehydrogenation of lower alkenes with molecular oxygen by using an oxidative dehydrogenation catalyst with a multimetal mixed oxide with the components  $Sb_{1-99}Mn_{1-50}O_x$ . (abstract; column 1, lines 9-14; column 2, lines 47-52; column 5, line 14; column 16, lines 13-14). The temperature range of the reaction is from 350°C to about 500°C (column 6, lines 7-10) and the catalyst can be supported on a variety of inorganic carriers (column 4, lines 1-17).

Schlaefer et al. is deficient in the sense that it does not explicitly state the addition of sulfate to the mixed metal oxide.

Croce et al. teaches that the yield of oxidative dehydrogenation reactions are improved, specifically of alkenes and aldehydes (column 2, line 56-61), by using a sulfur promoter as part of the catalyst (abstract). The sulfur can be incorporated in the form of sulfate (column 1, lines 40-41).

Therefore, it would be prima facie obvious to one of ordinary skill in the art at the time of the invention, to add Croce et al.'s sulfate promoter to Schlaefer et al.'s catalyst for the oxidative dehydrogenation process. One of ordinary skill in the art would be motivated to add sulfate to the catalyst, with the reasonable expectation that the purity would increase. Absent any showing of unusual and/or unexpected results over Applicant's particular sulfate catalyst, the art obtains the same effect on the process steps and yield. The expected result would be the efficient production of unsaturated aldehydes and unsaturated acids for the chemical industry."



Applicants respectfully traverse the rejection because the *prima facie* case of obviousness has not been established.

The Federal Circuit has ruled that a *prima facie* case of obviousness must establish: (1) some suggestion or motivation to modify the references; (2) a reasonable expectation of success; and (3) that the prior art references teach or suggest all claim limitations. Amgen, Inc. v. Chugai Pharm. Co., 18 USPQ2d 1016, 1023 (Feb. Cir. 1991); In re Fine, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988); In re Wilson, 165 USPQ 494, 496 (C.C.P.A. 1970).

Applicants note that the "teaching-suggestion-motivation" test for obviousness is still applicable following the Supreme Court decision in KSR International Co. v. Teleflex Inc. 550 U.S. - , 82 USPQ2d 1385 (2007) and that there is no teaching, suggestion or motivation in the cited reference to induce one of ordinary skill in the art to derive the present invention from the disclosure of Gokuraku, et al.

A *prima facie* case of obviousness must also include a showing of the reasons why it would be obvious to modify the references to produce the present invention. See Ex parte Clapp, 277 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985). The examiner bears the initial burden to provide some convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings. Id. at 974.

According to the Office Action, the examiner contends that: "The instant claims are drawn to a process for producing

unsaturated aldehydes and unsaturated acids by the vapor phase oxidative dehydrogenation of C2 to C5 alkenes with molecular oxygen by using an oxidative dehydrogenation catalyst with a multimetal mixed oxide as described in claim 1"

By that statement, the examiner is completely ignoring the clear fact that the present invention and the claims reciting that invention are drawn to a process for producing unsaturated aldehyde and unsaturated acid from C<sub>2</sub> to C<sub>5</sub> alkanes, not alkenes, that the C<sub>2</sub> to C<sub>5</sub> alkanes are subjected to vapor phase oxidative dehydrogenation in the presence of molecular oxygen and an oxidative dehydrogenation catalyst comprising a multimetal mixed oxide having the formula



where Mn denotes manganese;

O denotes oxygen;

E<sup>1</sup> represents one or more metal elements selected from the group consisting of phosphorus, arsenic, antimony, boron, sulfur, selenium, tellurium, fluorine, chlorine, bromine, iodine, niobium, tantalum, tungsten, rhenium and copper;

E<sup>2</sup> represents one or more metal elements selected from the group consisting of chromium, iron, cobalt, nickel, silver, gold, zinc, thallium, tin, lead, bismuth, lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium, barium, yttrium, lanthanum, cerium, neodymium, and samarium; and,

$\alpha$ ,  $\beta$ ,  $\gamma$  and  $x$  denote atomic numbers of Mn, E<sup>1</sup>, E<sup>2</sup>, and oxygen, respectively, and,

when  $\alpha=1$ ,  $\beta=0.01-10$ ,  $\gamma=0-5$ , and  $x$  has a numerical value determined by the state of oxidation of the elements other than oxygen to produce the alkenes which are then subjected to vapor phase oxidation in the presence of molecular oxygen and a further catalyst comprising a molybdenum-containing, multimetal, mixed oxide catalyst to produce the unsaturated aldehydes and unsaturated acids.

Thus, in the outstanding grounds of rejection, the examiner is completely ignoring the first step of the recited process which involves producing alkenes from alkanes using the recited manganese-containing multimetal, mixed oxide catalyst.

Considering the teaching of Schlaefer et al., Applicants point out that, not only does the reference not exemplify Applicants' manganese containing catalyst of Formula (1), it also fails to disclose the drying temperature and space velocity, and is further deficient in the sense that it does not explicitly state the addition of sulfate to the mixed metal oxide, all as admitted by the examiner. Schlaefer, et al. is also completely silent as to the vapor phase oxidative dehydrogenation of  $C_2$  to  $C_5$  alkanes in the presence of molecular oxygen and an oxidative dehydrogenation catalyst comprising a multimetal mixed oxide having the Formula (1) as recited in the present claims.

Accordingly, Schlaefer, et al., U.S. 4,078,004 is not applicable as a reference supporting an obviousness rejection under 35 U.S.C. 103(a) since it fails to teach or suggest all claim limitations of the present application. The teaching of

Schlaefer, et al., is only valid as to the vapor phase oxidation of alkenes to unsaturated aldehydes and acids using a multimetal mixed oxide of antimony and manganese, not for the first oxidative dehydrogenation step of C<sub>2</sub>-C<sub>5</sub> lower alkanes in the presence of the catalyst of Formula (1)  $Mn_aE^1_bE^2_cO_x$  as defined in the present claims. Whether or not one of ordinary skill in the art would find it obvious to determine the appropriate drying temperature and space velocity as suggested by the examiner is irrelevant in view of the above-noted lack of any teaching as to the effectiveness of Schlaefer, et al., to the oxidative dehydrogenation of C<sub>2</sub> to C<sub>5</sub> lower alkanes.

As for Croce, et al., Applicants respectfully submit that this reference fails to cure the deficiencies of Schlaefer, et al. Even if one considered the teaching of Croce, et al., as supporting the inclusion of sulfur as part of an oxidative dehydrogenation catalyst, applying that teaching to Schlaefer, et al., is limited to the vapor phase oxidation of alkenes to unsaturated aldehydes and acids as taught by Schlaefer, et al., not to the complete process of the present invention which has as its first step the oxidative dehydrogenation of C<sub>2</sub>-C<sub>5</sub> lower alkanes to the corresponding alkenes in the presence of the catalyst of Formula (1)  $Mn_aE^1_bE^2_cO_x$  as defined in the present claims.

In the absence of a teaching of the first step of the present invention:

subjecting C<sub>2</sub> to C<sub>5</sub> alkane to vapor phase oxidative dehydrogenation in the presence of molecular oxygen and an oxidative dehydrogenation catalyst comprising a first multimetal, mixed oxide catalyst having the formula (1):



where Mn denotes manganese;

O denotes oxygen;

E<sup>1</sup> represents one or more metal elements selected from the group consisting of phosphorus, arsenic, antimony, boron, sulfur, selenium, tellurium, fluorine, chlorine, bromine, iodine, niobium, tantalum, tungsten, rhenium and copper;

E<sup>2</sup> represents one or more metal elements selected from the group consisting of chromium, iron, cobalt, nickel, silver, gold, zinc, thallium, tin, lead, bismuth, lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium, barium, yttrium, lanthanum, cerium, neodymium, and samarium; and,

α, β, γ and x denote atomic numbers of Mn, E<sup>1</sup>, E<sup>2</sup>, and oxygen, respectively, and,

when α=1, β=0.01-10, γ=0-5, and x has a numerical value determined by the state of oxidation of the elements other than oxygen,

to obtain C<sub>2</sub> to C<sub>5</sub> alkene,

neither Schlaefer, et al., nor Croce, et al., can support a rejection of the present claims under 35 U.S.C. 103(a).

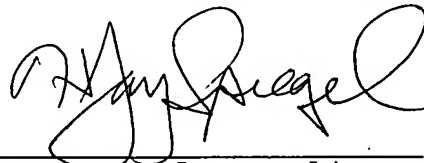
Accordingly, Applicants respectfully submit that the claims as amended herein are not obvious over the cited references and that the rejection under 35 U.S.C. §103(a) has been overcome and should be withdrawn.

In view of the foregoing, Applicants respectfully submit that the restriction requirement should be withdrawn and that the present grounds of rejection are without support in the prior art and should be withdrawn, and that claims 9-15 and 22-28, as amended herein, are allowable over the prior art.

Applicants respectfully submit that the present application is in condition for allowance and an early notice thereof is respectfully requested.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'H. Jay Spiegel', is written over a horizontal line.

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